

Key Impacts and Issues for WA Coasts and Infrastructure: Preparation and Adaptation to Climate Change

Overview

Impacts of sea level rise (SLR) in Washington's coastal regions include:

- Increased frequency of damaging storms and floods
- Gradual inundation of low-lying areas
- Increased erosion rates
- Loss or major shifts in nearshore habitats
- Escalating costs of maintaining and repairing near-sea level infrastructure
- Effects on shellfish harvesting and agriculture in coastal areas
- Seawater intrusion into coastal aquifers

The phenomena we anticipate experiencing in our coastal areas include:

- Storms
 - Damaging storms will occur *more frequently*
 - *Damage* from storms will increase due to high water levels and increased wave action
 - Severity of storms *may* increase – independently of sea level rise
- Coastal flooding
 - Extreme high water levels will increase over time
 - Flood events of any given magnitude will become more frequent
 - Longer flood durations
 - Drainage of low-lying areas more difficult
- Flood Frequency
 - On Puget Sound, the difference between 10 year and 100 year flood is about 1 foot.
 - A 1' rise in sea level will result in a 100 year flood becoming a 10 year event
- Erosion and landslides
 - Erosion rates likely to increase in most locations
 - Landslides more frequent and possibly larger
 - Erosional events will occur more often
 - Patterns of sediment transport on beaches will be altered, leading to complex, perhaps rapid shoreline changes

Key issues regarding coastal response to SLR:

- We need to think about responding to *events*, not just chronic inundation over the next 100 years.

- SLR will occur as escalating series of disasters
- Storm damage and emergency repairs, including insurance issues, will drive our response
- Different shorelines will *respond* differently
 - Key factors are geomorphic setting and land use
- *Resilience* is the key to sustaining both natural and built environments.

Key Issues Affecting Natural Environments

Coastal natural environments include:

- River deltas
- Bluffs, Beaches, and Spits
- Estuaries and Lagoons

● **River Deltas:**

Low-lying river deltas are subject to extensive inundation. Extent will depend on degree of diking and commitment to maintaining protection as costs escalate. Most deltas are dominantly agricultural. A few are urban and industrial.

Key impacts and issues include:

- Increased costs of repairing and maintaining dikes and levees
- Loss of nearshore habitats seaward of dikes
- Increased flooding, soil saturation, drainage problems
- Significant influence on long term decisions regarding agricultural use or ecological restoration
- Increased intrusion of saltwater into estuary

● **Coastal Bluffs**

Coastal bluffs are a widespread landform on Puget Sound. Primarily these have residential development. These sites are often hazardous due to erosion and landslides. Extensive armoring has occurred; existing concerns about long-term ecological impacts of armoring are heightened when considering beach resilience to SLR.

Key impacts and issues of include:

- Increased erosion rates and landsliding
- Escalating damage to seawalls, with need for progressively larger, more expensive measures over time
- Beach habitats squeezed out where shorelines are armored
- Shift from forested bluffs to unstable bare slopes
- Changes in bluff erosion may impact beaches elsewhere along shoreline

- **Spits and Barrier Beaches**

Spits and barriers are common on Puget Sound. Many protect valuable salt marshes and estuaries. Residential development is common, although many remain as relatively undeveloped parks and reserves.

Key Impacts and Issues include:

- Increased frequency and severity of flooding and storm damage
- Rapid erosion and potential for breaching
- Failure of septic systems; threat to water supply and utilities
- Loss of beaches where shoreline is armored
- Loss of associated wetland and estuarine habitats

- **Nearshore Habitats**

Nearshore habitats include beaches, salt marshes, tide flats, stream mouth estuaries, and lagoons. Increasingly these are targets of restoration actions. The SLR vulnerabilities of these sensitive areas need to be considered in our efforts to protect nearshore habitat.

Key issues regarding resilience of habitat include:

- Rate of sea level rise
- Ability to migrate
- Sediment availability

Key impacts and issues regarding nearshore habitat include:

- *Habitats will be eliminated if they cannot migrate landward.* Where habitat still exists in front of diked areas, the adaptability of nearshore habitat should be considered along with the cost of dike maintenance in deciding future maintenance or expansion of rural area dikes. This should especially be considered where the protected areas are marginally productive or relatively small.
- Tidal dynamics and sedimentation likely to change. This will change the type and condition of nearshore habitat (for good or bad, depending on the needs of particular species)
- Viability of restoration actions will change or become less certain. Where property is intended for long-term protection, long-term SLR should be considered in restoration and/or acquisition planning.

Key Issues Affecting Our Built Environments

The impacts on **residential and natural areas** are generally described above. Many of our coastal bluffs on Puget Sound are developed into residential uses. Erosion events are anticipated to increase. **Agriculture** is a dominant land use in most of our delta areas. Dikes will be threatened and drainage will become more difficult due to SLR. In some areas, **cultural resources** may be threatened by SLR.

Of special concern for SLR are our highly-developed **urban waterfronts**. Here, major infrastructure is threatened by SLR. Significant investment may be necessary to protect or adapt this infrastructure to SLR. Key issues related to urban waterfronts include the following:

- **Urban Waterfronts**

Shorelines of our urban areas are largely modified by landfill and seawalls. Extensive overwater development and marine facilities have been construction. In these areas, we have major investments in public and private infrastructure. But in some cases – such as our most active ports – redevelopment and upgrade is an on-going process. We will need to consider how we invest in maintenance and upgrade to maximize adaptation and resilience related to sea level rise.

Key Impacts and Issues for our urban waterfronts include:

- Increased risks to infrastructure such as
 - Treatment Plants
 - Transportation Corridors
 - Commercial and Industrial Waterfronts
 - Parks
- Storm drainage systems require expensive fixes
- Increasingly steep public costs to maintain, protect, and repair public facilities and property
- Redevelopment opportunities

- **Ports**

Ports usually have heavily engineered shorelines. Freight handling requires extensive rail yards near water level. Associated industrial areas may contain currently or historically contaminated sites, creating risk of increased water pollution as sea level rises.

Key Impacts and Issues include:

- Increased maintenance and repair of port facilities
- Increasing storm damage to piers and seawalls
- Need to reconfigure or elevate freight handling yards
- Increased corrosion of tanks and pipes; increased leaching of contaminated soils
- Opportunity to adapt during major facility updates

These key impacts and issues should frame our design of preparation/adaptation strategies.